

CLAIMS

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1. A method for depositing particles from an aerosol onto a dielectric substrate comprising the steps of charging said aerosol particles, positioning said charged aerosol particles in a deposition zone proximate to said dielectric substrate, and applying an alternating electric field in said deposition zone by which said charged particles are removed from the aerosol and deposited on said dielectric substrate thus forming a deposit.

2. The method according to claim 1, wherein said deposit has relatively more mass than a deposit that can be formed using a static electric field.

3. The method according to claim 1, wherein said aerosol particles are charged.

4. The method according to claim 1, wherein said aerosol particles comprise particles of dry powder.

5. The method according to claim 1, wherein said aerosol particles comprise liquid droplets.

6. The method according to claim 4, wherein said dry powder particles are triboelectrically charged.

7. The method according to claim 5 wherein said liquid droplets are charged by a charge injector during droplet formation.

8. The method according to claim 1, wherein said aerosol particles comprise a pharmaceutical.

- 1 9. The method according to claim 4, wherein said dry powder particles
2 comprise carrier particles coated with a bioactive agent.
- 3 10. The method according to claim 3, wherein said aerosol particles have a
4 higher charge to mass ratio than is achievable using triboelectric charging.
- 5 11. The method according to claim 10, wherein said charged aerosol particles
6 achieve a relatively higher velocity than that achievable with triboelectrically charged
7 particles thereby forming said deposit more quickly.
- 8 12. The method according to claim 1, wherein said aerosol particles are
9 charged within said deposition zone.
- 10 13. The method according to claim 1, wherein said aerosol particles are
11 charged outside of said deposition zone.
- 12 14. The method according to claim 1, wherein said alternating electric field
13 has a magnitude between 1KV/cm and 30KV/cm.
- 14 15. The method according to claim 1, wherein the frequency of said
15 alternating electric field is between 1Hz and 100KHz.
- 16 16. The method according to claim 1, wherein the duty cycle of said
17 alternating field is substantially different than 50%.
- 18 17. The method according to claim 16, wherein said duty cycle is 90%.
- 19 18. The method according to claim 1, wherein said alternating electric field is
20 formed between a first electrode positioned at an end of said deposition zone opposite

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- 1 to and facing said dielectric substrate and a second electrode in contact with said
2 dielectric substrate on the opposite side of where said deposit is formed.
- 3 19. The method according to claim 18, wherein said first electrode is an
4 element of an ion emitter.
- 5 20. The method according to claim 19, wherein said aerosol particles are
6 discharged after being deposited.
- 7 21. The method according to claim 18, wherein the contact area of said second
8 electrode with said dielectric substrate determines the location of said deposition.
- 9 22. The method according to claim 1, wherein substantially all of said aerosol
10 particles are removed from said aerosol to form said deposit.
- 11 23. The method according to claim 1, wherein the gas of said aerosol is
12 predetermined.
- 13 25. The method according to claim 1, wherein said dielectric substrate
14 comprises a packaging medium.
- 15 26. The method according to claim 25, wherein said packaging medium
16 comprises a blister, tablet, capsule or tablet. 2.13/5/01
- 17 27. The method according to claim 26, wherein the blister comprises a plastic
18 or metal foil blister package.
- 19 28. The method according to claim 1, wherein said dielectric substrate
20 comprises a pharmaceutical carrier.

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29. The method according to claim 1, wherein said dielectric substrate comprises a carrier for carrying said deposit from said deposition zone to another location for further processing.
30. The method according to claim 1, wherein said dielectric substrate is edible.
31. The method according to claim 3, wherein said ion emitter comprises a corona wire or corona point.
32. The method according to claim 3, wherein said ion emitter comprises a silent electric discharge device.
33. The method according to claim 3, wherein said ion emitter comprises an ionizing radiation source.
34. The method according to claim 12, wherein said aerosol particles are charged by an ion emitter.
35. The method according to claim 22, wherein the mass of said deposit is controlled by integrating the mass of said aerosol particles over a period of time.
36. The method according to claim 35, wherein said period of time is determined by the measured mass of said aerosol particles.
37. The method according to claim 22, wherein multiple deposits may be made using multiple deposition zones supplied from a single aerosol source by multiplexing the application of the alternating deposition field between the deposition zones.

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1 38. A controlled quantity of powder carried on a substrate, comprising a
2 plurality of layers of said powder in which adjacent layers carry opposite charges.

3 39. A controlled quantity according to claim 38, wherein said powder
4 comprises a pharmaceutical.

5 40. A controlled quantity according to claim 38, wherein said substrate
6 comprises a packaging medium.

7 41. A controlled quantity according to claim 40, wherein said packaging
8 medium comprises a blister, tablet, capsule or tablet.

9 42. A controlled quantity according to claim 41, wherein said blister
10 comprises a plastic or metal foil blister package.

11 43. An apparatus for depositing onto a substrate controlled quantities of
12 particulate material from a source of said material, said apparatus comprising a charge
13 generator for applying a predetermined electrostatic charge to particles of said material
14 upstream of a deposition zone in which said substrate is located, and a controller for
15 repeatedly varying the polarity of charge being applied to said material and to said
16 substrate.

17 44. The apparatus according to claim 43, wherein the controller comprises a
18 switch oscillator.

19 45. The apparatus according to claim 43, wherein the controller includes a
20 clock for varying the polarity of charge over time.

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1 46. The apparatus according to claim 43, wherein said controller is adapted to
2 switch polarity applied to said powder and to said substrate in synchronization.

3 47. The apparatus according to claim 43, and including sensors for measuring
4 the mass flow of aerosol particles that pass into and out of the deposition zone.

5 48. A method for depositing particles from an aerosol onto a substrate that
6 comprises moving an aerosol through a deposition region, providing means for
7 electrically charging said particles, and providing an alternating electric field between
8 said substrate and said aerosol particles whereby said particles are deposited on the
9 surface of said substrate.

10 49. The method according to claim 48, wherein said particles are solid.

11 50. The method according to claim 48, wherein said particles are liquid.

12 51. The method according to claim 48, wherein said particles comprise carrier
13 particles coated with a bioactive agent.

14 52. The method according to claim 48, wherein said particles comprise a
15 pharmaceutical.

16 53. The method according to claim 48, wherein said aerosol carrier is nitrogen
17 gas.

18 54. The method according to claim 48, wherein said substrate comprises a
19 blister pack.

20 55. The method according to claim 48, wherein said substrate is comprised of
21 an electrically insulating material.

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1 56. The method according to claim 48, wherein said substrate is comprised of
2 an electrically conducting material.

3 57. The method according to claim 48, wherein said electrically charging
4 means employs a corona wire.

5 58. The method according to claim 48, wherein said electrically charging
6 means employs corona emitting points.

7 59. The method according to claim 1, wherein said electrically charging
8 means includes a charge source comprising a solid dielectric member, a first electrode
9 substantially in contact with one side of said solid dielectric member, a second electrode
10 substantially in contact with an opposite side of said solid dielectric member, with an
11 edge surface of said second electrode disposed opposite said first electrode to define an
12 air region at the junction of said edge surface and said solid dielectric member, and
13 means for applying an alternating potential between said first and second electrodes of
14 sufficient magnitude to induce ion producing electrical discharges in the air region
15 between the dielectric member and the edge surface of said second electrode.

16 60. The method according to claim 48, wherein said electrically charging
17 means includes triboelectric charging of said aerosol particles.

18 61. The method according to claim 48, wherein said electrically charging
19 means includes induction charging of said aerosol particles.

20 62. The method according to claim 48, wherein said aerosol particles are
21 charged outside of said deposition region.

1 63. The method according to claim 48, wherein said aerosol particles are
2 charged within said deposition region.

3 64. The method according to claim 48, wherein said electrically alternating
4 field has a magnitude between about 1 kV/cm an about 30 kV/cm.

5 65. The method according to claim 48, wherein said electrically alternating
6 field has a frequency of oscillation between about 1 Hz and 100 kHz.

7 66. The method according to claim 48, wherein the duty cycle of the
8 alternating field is adjusted to provide maximum efficiency of said particle deposition.

9 67. The method according to claim 48, wherein said electrically alternating
10 field is formed between a first electrode positioned at one side of said deposition region
11 opposite and facing said substrate and a second electrode contiguous to said substrate.

12 68. The method according to claim 48, wherein the pattern of deposited
13 material is defined by the geometry of said alternating electric field.

14 69. The method according to claim 48, wherein the pattern of deposited
15 material is defined by an electrically conducting mask disposed adjacent said charging
16 means.

17 70. The method according to claim 48, wherein the aerosol particle mass flow
18 is monitored whereby the mass of deposited particles is controlled.

19 71. The method according to claim 48, wherein multiple deposits may be
20 made using multiple deposition regions supplied from a single aerosol source by

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1 multiplexing the application of the alternating deposition field between the deposition
2 regions.

3 72. A pharmaceutical unit dose medicament powder package wherein the
4 powder is deposited using electrostatic means to form alternately charged layers of said
5 powder.

6 73. The package of claim 72, wherein said electrostatic means includes
7 moving an aerosol through a deposition region, providing means for electrically
8 charging said medicament powder, and providing an alternating electric field between
9 said powder package and said aerosol.
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